

APPLICATION OF ARTIFICIAL INTELLIGENCE IN DETECTION AND PREVENTION OF PEER VIOLENCE: A LITERATURE REVIEW

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Abstract: *Peer violence in schools is a serious social problem that can have long-lasting and detrimental effects on the mental health of children and youth. Recently, the application of artificial intelligence (AI) has been on the rise across all sectors of society, with modern research indicating its potential use in the detection and prevention of peer violence. The aim of this research is to review the literature on peer violence with a special focus on the possibilities of implementing AI in detecting and preventing this social issue. Through a systematic review of the literature, current and relevant studies addressing peer violence, as well as those exploring the use of AI in education, specifically in the detection and prevention of peer violence, were analyzed. The research findings show that AI can significantly contribute to the early detection of indicators pointing to peer violence through the analysis of text, speech, social interactions, and social media. Additionally, the main advantages and challenges of applying AI were identified, including legal and ethical issues and cultural sensitivity.*

The conclusion of the paper emphasizes the importance of an interdisciplinary approach in the implementation of AI for combating peer violence, as well as the need for further research to enable more effective use of such solutions in real-world conditions.

Keywords: *peer violence, artificial intelligence, prevention, literature review.*

INTRODUCTION

Peer violence in schools is a serious social problem that can have long-lasting and detrimental effects on the mental health of children and youth. According to research conducted in the United States, about 20% of high school students experience some form of peer violence, and about 70% of students report witnessing some form of violence in school (Nansel et al., 2001). Globally, an average of 10–30% of adolescents have reported experiencing some form of violence (Cook et al., 2010; Schoeler et al., 2018). A study on school violence from 2014 shows that about 30% of elementary school students experienced violence at least once during their schooling, with the percentage increasing in higher grades (Popadić et al., 2014). It is important to note that the reason for recording higher percentages in higher grades may not necessarily be an increase in violence, but rather that older students can better detect different forms of violence.

Peer violence can manifest in various ways, including physical violence, verbal harassment, social exclusion, and the like. Recently, digital violence has also become an increasingly relevant form of peer violence. According to the Law on the Basics of the Education System, digital violence and abuse involve the misuse of information and communication technologies that can result in harm to another person and endanger dignity (ZOSOV, 2023). Peer violence can have serious consequences for the mental health of children and youth, including stress, anxiety, depression, increased risk of substance abuse, and suicide (Bradshaw et al., 2015), making the development of effective strategies

for preventing peer violence essential. Research has shown that a strengths-based approach can be very effective in preventing peer violence. This approach focuses on identifying and strengthening existing strengths and resources in children and youth, rather than their deficiencies and weaknesses.

Modern research also demonstrates the effectiveness of AI-based resources in detecting and preventing peer violence. Techniques of deep learning and natural language processing (NLP) have been proposed for real-time violence detection from surveillance footage, including identifying firearms, robbery, fights, sexual harassment, and fires in video recordings (Davidson et al., 2017). AI-based mechanisms, such as automatic speech recognition (ASR), have been proposed for addressing domestic violence cases during the pandemic, where physical access to authorities was limited (Davidson et al., 2017). Additionally, real-time violence detection systems using deep learning on unmanned aerial vehicles (UAVs) have been developed, improving requirements such as computational speed, model capacity, accuracy, and object tracking technology (Pham Van, 2023). These AI-based approaches also offer efficient, fast, and precise solutions for detecting and preventing violence, enabling timely intervention and ensuring the safety and security of individuals and society as a whole. With the return of students to schools after the global pandemic, school associates, parents, and students have faced new challenges, motivating researchers to apply AI-based approaches to detect and prevent peer violence in schools.

PEER VIOLENCE

Recently, increasing attention has been given to preventive programs aimed at reducing the incidence of this type of violence among youth. One approach based on the strengths perspective involves implementing information technologies and artificial intelligence (AI) programs that facilitate the easier detection of various forms of peer violence, thereby leading to more effective prevention.

Peer violence is a serious social problem occurring worldwide. Although violence can be defined as the negative behavior of one person that endangers the safety, physical or mental health, and dignity of another person, broader and narrower definitions of this phenomenon can be found in the literature, indicating a very extensive denotation of the term. A broader definition of violence is given by Milosavljević (1998), who defines it as actions and behaviors of an individual or group, social institution, or organization, which involve the use of force – whether psychological, physical, or of another kind – that endangers human integrity and leaves consequences.

Olweus defines violence as persistent negative behavior by one or more individuals directed at another person with the aim of endangering safety or rights (Olweus, 1997). Similarly, with the exception of the persistence aspect, the Law on the Basics of the Education System defines violence as “any form of verbal or non-verbal behavior, whether single or repeated, that results in actual or potential endangerment of the health, development, and dignity of a child, student, or adult.” The same definition is found in the Manual for the Implementation of the Special Protocol (2009), which also presents a classification of violence according to its form:

1. Emotional/psychological violence – immediate or prolonged endangerment of the child’s psychological or emotional health;
2. Physical violence – actual or potential physical injury to the child/student;
3. Electronic violence – misuse of information technologies;
4. Sexual violence – involving children in sexual activities they do not understand and are not developmentally ready for;
5. Social violence – excluding a child or children from the group (Manual, 2009).

Peer violence occurs when violence happens between children of the same or similar age. Jerković (2010) adds that it is possible to detect an unequal power relationship in the occurrence of peer violence, meaning that the child subjected

to peer violence is weaker and more helpless compared to the peer or group of peers, while the literature on peer violence additionally emphasizes persistence. Based on this, certain characteristics and a definition of peer violence can be derived for further research purposes:

1. Intent to endanger the physical, psychological, or emotional health of another child or group of children of the same or similar age.
2. Actual or potential endangerment of the physical, psychological, or emotional health of another child or group of children of the same or similar age.
3. Peer violence involves an unequal power relationship or imbalance of power (Manual, 2009), where the victim is weaker and more helpless, and the perpetrator is more powerful and stronger.
4. Peer violence most often implies continuity, i.e., the persistent endangerment of the physical, psychological, or emotional health of another child or group of children of the same or similar age.

Based on these characteristics, we can deduce the definition of peer violence for further research purposes: Peer violence is intentional and persistent behavior by an individual or group aimed at actually or potentially endangering the physical, psychological, or emotional health of another child or group of children of the same or similar age, and can be carried out verbally, through physical force, psychological or social treatment of an individual or group, or by using information technologies.

Thus defined, peer violence is present in all social strata and cultures and has serious consequences for the health and well-being of children and youth. According to UNICEF research, peer violence occurs in almost all countries worldwide. It is most prevalent in South American countries, Central and Eastern Europe, as well as in Asia and Africa (UNICEF, 2017). In some countries, such as the USA and Canada, it is estimated that peer violence affects nearly 30% of children and youth, as confirmed by WHO research from 2018. Data on peer

violence in Serbia also aligns with global research. A study on school violence from 2014 shows that about 30% of elementary school students experienced violence at least once during their schooling (Popadić et al., 2014).

In recent years, the problem of peer violence has become increasingly prominent in public and media discourse, which does not necessarily mean that peer violence is more prevalent, but may indicate positive outcomes of initiatives and actions aimed at reporting violence, as well as positive outcomes of educating students, teachers, and professional associates about this problem to ensure adequate response and better detection of various forms of peer violence.

According to the research by Popadić and associates (2014), boys are more often involved in physical violence, while girls are more often subjected to verbal and psychological violence. The most common forms of peer violence in Serbia are insults, belittlement, spreading rumors, exclusion from groups, as well as physical violence such as hitting and pushing. An increasingly prevalent form of peer violence is electronic violence, to which girls are particularly exposed.

At the end of the 20th century, the phenomenon of peer violence began to be approached from a group perspective, recognizing that in situations of peer violence, it is not possible to isolate solely the victim or the perpetrator of violence. Initial research showed that six roles could be identified in an act of peer violence: victim, perpetrator, accomplice, instigator of the perpetrator, observer (outsider), or defender of the victim (Salmivalli et al., 1996). Subsequent research further expanded this list, so in Olweus' work, we find eight roles depending on whether they have a positive, neutral, indifferent, or negative attitude towards peer violence, or whether they are direct participants or not (Olweus, 2001). This research indicates that peer violence is not solely a problem of the perpetrator and the victim but involves a larger number of subjects with different roles and participation in this issue, opening the door to ecological systems theory in a sociological sense, i.e., an approach that encompasses a larger number of participants and their interpersonal connections.

176 The consequences of peer violence in Serbia can be very serious, including depression, anxiety, suicidal thoughts, decreased academic achievement, increased absenteeism from school, and health problems, while the negative

impact affects not only the victim of peer violence but also the perpetrator, their families, and society as a whole.

METHODOLOGY

To conduct a thorough and systematic review of the available literature on the application of artificial intelligence (AI) in the detection and prevention of peer violence, ensuring a high level of rigor and objectivity in the analysis and synthesis of collected data, diverse sources of information relevant to the topic were included according to established criteria.

The following databases and search tools were used to identify relevant literature: Web of Science, Scopus, Google Scholar, PubMed, IEEE Xplore, as well as specialized educational databases such as ERIC (Education Resources Information Center). Searches were conducted using keywords and phrases, and their combinations, such as “artificial intelligence and bullying prevention”, “machine learning in education”, “detection of cyberbullying”, “information technology and school bullying”, “AI school bullying detection”, “school bullying prevention”, The search also included Serbian translations of these terms and phrases.

For the literature review, works that directly address the topic of peer violence and the application of artificial intelligence, with a particular focus on the detection and prevention of violence, were selected. The literature included a wide range of academic works, including articles published in peer-reviewed journals, books, doctoral dissertations, and conference papers, as well as reports from relevant international and national organizations.

The search yielded 129 research and theoretical papers, after which criteria were applied to include the works in the literature review. Included in the review were those papers specifically focused on the application of artificial intelligence in the domain of peer violence detection and prevention, as well as those published from 2014 to 2024 to ensure the relevance and currency of the data. Exclusion criteria for the literature involved insufficient focus on artificial intelligence or peer violence. Additionally, works published before 2014 and

those lacking empirical evidence to support their conclusions were excluded from the review.

Only 13 papers met the established criteria from which key information, methods, findings, and conclusions were extracted. The analysis also included a critical review of the methodologies used in the studies, an assessment of the validity and reliability of the findings, and a discussion of the potential implications for practice and future research

APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE DETECTION AND PREVENTION OF PEER VIOLENCE

While the topic of peer violence is globally widespread and thoroughly researched, its relevance persists. The application of AI-based tools has only seen significant expansion in the past decade, limiting the scope of research on this topic. A study by Topcu-Uzer and Tanrikulu (2018) highlighted that information technology tools are not yet capable of reliably and consistently detecting and preventing cyber or other forms of violence. Until 2020, the number of studies indicating the effectiveness of new technological solutions against peer violence and cyberbullying was very limited, with exceptions in systems like text-based detection (Soundar and Ponesakki, 2016), participant vocabulary coherence (Raisi and Huang, 2016), or morphosemantic patterns (Ptaszynski et al., 2016). Moreover, recent studies, such as the Rethink software and empathy-increasing video materials, are being conducted to combat these issues. These will be key elements in developing new technological solutions to fight bullying and cyberbullying and in future research demonstrating their effectiveness.

In 2018, Silva et al. conducted a literature review focusing on interventions aimed at preventing peer violence in schools. Although the study did not analyze the effectiveness of AI and digital tools, the conclusions can be applied to peer violence prevention in general. Silva et al. classified interventions into four categories: multi-component, involving the entire school, social skills training, academic within the curriculum, and computerized. Each category was

thoroughly researched in relation to relevant research databases, indicating a high effectiveness rate for interventions involving multiple components and the entire school community, and those adapted to the cultural and social factors of all school community members (Silva et al., 2018). This suggests the necessity for implemented solutions to be tailored to the school community environment and the characteristics of students to establish better intervention effectiveness.

However, certain studies from 2014 indicate the implementation of modern solutions in the field of information technology, such as the detection of emotional states using smartphones in controlled environments for detecting peer violence in schools (Hany et al., 2014). By classifying emotions in the form of frequencies displayed on an electrocardiogram, this research helped establish a connection between the emotions of participants and the MAHNOB database using a smartphone and sensors (Hany et al., 2014). This laid the groundwork for detecting fear, power, and other emotions significant for detecting the prevalence of peer violence among children and youth, paving the way for the implementation of AI-based solutions for these purposes.

The primary use of artificial intelligence was observed in the application of machine learning algorithms to analyze patterns in data collected from schools. For instance, Yan et al. (2023) used machine learning to identify risk factors and prevent victimization resulting from peer violence among adolescents. This study used algorithms to analyze data from over 410,000 students, contributing to high accuracy in outcome prediction. Kumar et al. (2021) developed an AI-based system using neural networks, image processing, and natural language processing to monitor bullying situations in primary and secondary schools. This system integrates data from various sources, such as surveillance cameras, social media, and school records, and it successfully identified victims and perpetrators of peer violence with an accuracy of 87%.

Cedillo et al. (2022) reviewed literature published from 2009 to 2021 to offer a comprehensive overview of tools and methods in information technology used in the detection and prevention of physical and cyberbullying. From this perspective, the time period of the included studies is crucial for observing

the issue of peer violence, especially in virtual environments, considering the possibility of comparing data before and after the COVID-19 pandemic, during which many social interactions migrated from the physical world to virtual environments, contributing to an increase in cyberbullying incidents. Various methods were already used during this period in combating peer violence within the realm of information technology, such as video surveillance systems, serious games, and the use of artificial intelligence on distance learning platforms, all aimed at educating children and youth about this global problem, as well as providing monitoring and intervention capabilities.

The research highlighted a significant increase in technological solutions against peer violence but also a lack of studies confirming the effectiveness of these tools. Regarding artificial intelligence, perhaps the biggest challenge has been detecting elements of peer violence in written and verbal communication due to the inability to determine the appropriate context, which can lead to false results. Nonetheless, even without fully effective AI applications, the research has produced benefits from using IT tools in establishing engaging and educational programs that reduce the incidence of peer and cyberbullying. Therefore, this literature review serves as an excellent starting point for further research on the application of AI and digital tools in the detection and prevention of peer violence, emphasizing the need for empirical studies to examine the effectiveness of these tools and methods.

Milošević, Van Royen, and Davis (2022) investigated the application of AI in relation to cyberbullying, harassment, and abuse in terms of managing content that could harm students. This study particularly highlighted the complexity of peer violence in the virtual space, requiring a multidisciplinary approach that encompasses not only information technology but also psychology, sociology, and legal frameworks. The study specifically points to the frequent inability to restrict content, thereby posing challenges and difficulties in this regard. Consequently, peer violence perpetrated in this manner is often more

complex in terms of classification and ambiguity, potentially leading to multiple consequences for the victim's psychosocial and emotional well-being.

This complicates the detection of peer violence, considering AI's inability to recognize peer violence in language when irony, sarcasm, or ambiguous word meanings are used, which can lead to false positives in violence detection. Moreover, content in the virtual world can be transmitted in various forms, such as images, sound, text, or video, further affecting the meaning and context of the conveyed message. Finally, the challenge in content management also lies in the volume of content available on online platforms and social networks, with the number of posts continuously increasing in real time.

The authors mention several AI-based techniques that can be used for content management aimed at detecting peer violence. Natural language processing and machine learning can be automated to detect content that violates specific regulations, such as automatically removing images depicting pornographic content or posts containing derogatory language. Deep learning models can contribute to understanding the context and usage of words in a text, enhancing the precision and accuracy of detecting content that can be classified as peer violence. The research emphasizes the importance of an interdisciplinary approach in implementing these AI-based tools to prevent ethical issues related to the misuse of protected data, thereby providing protection for violence victims. Therefore, while the significance of using such tools is unquestionable, conditions must be met to ensure their proper implementation.

In a 2023 study, Milošević et al. continued researching these issues, analyzing the role of AI in combating peer violence from the perspective of adolescents and children, aligning with Silva et al.'s (2018) appeal for implementing measures and interventions that consider the needs of the research subjects. This study (Milošević et al., 2023) focused on addressing challenges identified in the previous year's research, such as children's right to privacy, protection, freedom of speech, and other ethical issues according to the United Nations Convention on the Rights of the Child (1989). The research was conducted in Ireland with children aged 12 to 17 who participated in interviews

and responded to questions within hypothetical scenarios involving AI-based content management strategies and their impact on their rights. While many participants generally accepted AI-based content management, many also expressed concerns about their privacy, particularly regarding private message exchanges and methods involving facial recognition. Participants also worried that such interventions might judge their communication with peers, potentially misinterpreting their intentions to joke in situations that AI might recognize as peer violence.

Thus, the implementation of AI-based tools necessitates respecting the privacy and personal data of the subjects to ensure the effectiveness of these tools.

Similar ethical issues were found in the research by Kumar et al. (2020). The advantage of Kumar et al.'s (2020) research is that it used existing infrastructure in many schools, such as video surveillance. The study focused on implementing advanced machine learning techniques in school surveillance systems to effectively detect peer violence. Using convolutional neural networks to analyze video recordings from surveillance cameras and long short-term memory to examine patterns in video and audio recordings, the research involved recognizing patterns related to peer violence from databases of surveillance cameras, student forums, platforms, and school records (attendance, logs, reports).

Indicators analyzed included physical violence, verbal abuse, social exclusion, and changes in academic performance and school activity attendance. The analysis also included assessing the emotional tone of written communication on student forums and platforms, contributing to an 87% accuracy in classifying situations and forms of peer violence. With this precision and automated real-time event monitoring via video surveillance and communication tracking, the research indicated the possibility of timely intervention both in schools and the virtual spaces used by students.

This study also highlighted the problem of context, specifically potential errors in detecting peer violence when using natural language in jokes, sarcasm,

irony, or other forms of statements that could be misinterpreted as peer violence without adequate context. Additionally, Kumar et al. noted the necessity of improving and implementing facial recognition to identify perpetrators and victims of peer violence, which potentially raises further ethical issues concerning biometric data and data protection.

Video surveillance was also used in the study by Orru et al. (2023). This research analyzed the “BullyBuster” project, which integrates AI, video surveillance, and psychological theories to implement a multidimensional system aimed at detecting and preventing peer violence in both physical and virtual environments. For example, it enables the detection of potential peer violence incidents through video surveillance and text analysis on social media and other platforms by detecting patterns. An addition compared to previous research is the analysis of typing patterns to detect potential aggression, and a module is implemented to detect content that could potentially harm a student’s safety or reputation. The project showed promising results, especially due to the implementation of protocols and measures compliant with European laws and regulations regarding data protection, further highlighting the importance of these ethical and legal issues in AI implementation.

Machine learning was also implemented in a study conducted in China by Yan et al. (2023) to identify risk factors for the occurrence of peer violence, both in physical and virtual environments. With the aim of early detection of potential peer violence and its risk factors, the study aimed to prevent peer violence by enabling timely intervention before it occurs. Using six different machine learning algorithms, the study collected and analyzed data from over 410,000 students, comparing them across more than 40 variables. The wide range of these variables (academic performance, personal and social factors, psychological and physical factors, etc.) enabled a holistic approach to the problem of peer violence, identifying the factors and indicators that most frequently contribute to its occurrence.

The “Random Forest” and “Light Gradient Boosting Machine” algorithms demonstrated the highest accuracy in predicting situations that could be detected as

peer violence. They also highlighted particularly risky social factors contributing to peer violence among victims, such as mental health issues, physical health problems and deformities, disrupted family or social dynamics, and living in inadequate conditions. These algorithms facilitated identifying individuals and classifying them as high-risk or low-risk for potential victimization, allowing not only timely reaction and preventive measures before violence occurs but also timely protection of victims, thus safeguarding the safety and emotional well-being of vulnerable students.

However, the research also points out the challenge posed by the large volume of data, algorithms, and the wide range of variables. With such extensive data, establishing precise causal links between risk factors and events that can be considered peer violence becomes difficult, complicating early detection and prevention. This problem could be addressed with more adequate classification following long-term model testing, which could also contribute to targeted interventions and preventive measures based on accurately detected risk factors.

Recently, the use of chatbots, or virtual assistants, has become more common. Lafrance and Villeneuve (2024) investigated the effectiveness of chatbots in combating school bullying. What sets chatbots apart from other tools is their interactivity and real-time response capability, given their ability to reply immediately to questions and their accessibility since chatbots are implemented in all smart devices. The study showed general acceptance among children to communicate with chatbots, primarily because they don't fear judgment and can freely express their thoughts and feelings. However, the challenges with chatbots stem from their advantages: the lack of a human factor in detecting emotions and states, which could significantly enhance the detection of peer violence. Additionally, chatbots may provide generic responses that are not entirely suitable for the student's situation, potentially increasing emotional stress instead of reducing it. However, the study suggests that chatbots are underutilized, considering that they, with minor improvements in emotional intelligence, can also generate valuable data for further research on peer violence and establish effective prevention programs.

Emotional intelligence and empathy are precisely human advantages over artificial intelligence, highlighting the importance of the research by Kim et al. (2021). Kim et al. explored current approaches to detecting cyberbullying through the lens of human emotions, states, and beliefs. The focus was on machine learning algorithms, and over 56 studies on this topic noted that the effectiveness of tools for combating peer violence largely depends on human parameters. For example, cyberbullying detection models do not include theoretical behavioral models or knowledge of the psychosocial dynamics of peer violence but rely solely on technical aspects, such as engineering scenario modeling. Additionally, anti-bullying models rarely validate data obtained through AI, affecting the effectiveness of the tools. Finally, there is a lack of long-term empirical studies considering not only the sustainability of these models but also managing consequences such as false positives, classification issues of peer violence, or ethical problems arising from personal data monitoring.

In other words, Kim et al. systematically highlight the necessity of including the human factor in implementing artificial intelligence (AI) in the detection and prevention of peer violence. This is due to humans' ability to detect emotional states and nuances in contexts where AI is applied, without excluding the benefits AI brings to combating peer violence.

CONCLUSION

The results of this research indicate that AI has significant potential in detecting and preventing peer violence. Automation and the application of AI-based technologies, such as natural language processing and machine learning, open up the possibility of timely detection of potential factors that can lead to peer violence. Unlike human factors, the use of AI allows for the processing of large amounts of data and rapid real-time detection. Early interventions are also facilitated by analyzing social interactions, both in physical and virtual environments, by AI-based technologies, which can contribute to classifying interactions and identifying risk factors. Additionally, the research pointed out

the shortcomings of AI applications, such as still inadequate identification of emotional content and personalized interventions when it comes to peer violence, which is the first step toward improving these functionalities.

However, research on the application of AI is consistent regarding potential challenges, such as ethical and cultural issues. The uniform stance of researchers and study subjects is that the application of AI carries ethical dilemmas, especially in the realm of privacy, data protection, and adequate content detection. Cultural factors can also threaten the effectiveness of AI applications, as cultural and generational differences can affect the appropriate interpretation of interactions, leaving room for false results.

One advantage of contemporary times is the easier integration of AI with existing educational systems and methods of social interaction (distance learning platforms, video surveillance, social networks, etc.), providing a large database for creating a comprehensive picture of the social dynamics within a school community. This can also contribute to monitoring changes in student behavior over time, enabling easier identification of trends and changes, and thus the easier implementation of measures and strategies to prevent peer violence. While these results show promising applications of AI in combating peer violence, it is essential to emphasize the need for additional empirical research to refine existing tools and gather information on the sustainability of such models and their long-term effects on students' psychosocial health, in their best interest.

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